Light and Lighting

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Lighthouses

AMONG the manifold uses of light in the service of man are those of indicating the whereabouts of places of safety, succour or danger. Many examples come readily to mind. If we are land-lubbers, we may think first of such things as luminous bollards on road islands; of obstruction warning lights; of lucent direction signs: perhaps, of the red lamp of the doctor's surgery, the blue lamp of the police-station or the porch lamp that marks our own home. Other examples will come first to those who sail the seas; the lights of ships that pass in the night, harbour lights and the lighthouses that cast their beams afar. As Dr. W. M. Hampton remarked in a recent paper to the I.E.S., "the use of lights as aids for mariners is probably as old as any application of light to human problems," Over 2,000 years ago Ptolemy II erected a great lighthouse on the island of Pharos outside the port of Alexandria. This was one of the wonders of the Ancient World, and only in comparatively recent times have more effective lighthouses become possible by the development of high intensity sources of artificial light and the construction of special lenses for controlling their light.

Notes and News

The Supply of Electric Lamps

The Report of the Monopolies and Restrictive Practices Commission on the Supply of Electric Lamps was published in November, 1951. The reference to the Commission by the Board of Trade was made on March 1, 1949, so the inquiry has taken nearly three years to complete. The electric lamp industry has many manufacturers who are not members of the Electric Lamp Manufacturers' Association, but the eleven members of the Association account for approximately 60 per cent. of the lamp market, and thus the Report deals to a major extent with the activities of the Association.

The inquiry provided an opportunity for the airing of grievances which time and again the Commission finds to be without evidence or without foundation. The suggestion, for example, that the life of electric lamps is kept shorter than necessary in the interests of the replacement business was thoroughly dealt with and considered to be misconceived; the Report explains clearly the problem facing the lamp manufacturer in securing the best combination of life and luminous efficiency, and states that ". . . there can be no absolutely right life for the many varying circumstances to be found among the consumers in any given country, so that any standard life must always represent a compromise between conflicting factors. B.S.I. has always adopted a single life standard for general service filament lamps, and the representatives of both B.S.I. and B.E.A., as well as most lamp manufacturers, have told us in evidence that they regard 1,000 hours as the best compromise possible at the present time, nor has any evidence been offered to us to the contrary. Accordingly we must dismiss as misconceived the allegation referred to above." This should effectually remove any lingering doubts in the minds of even the most uninstructed.

Another misconception disposed of is that unused patents are hoarded to hamper competitors. It is apparent that representations on this point were subject to a careful examination which revealed no evidence. In addition, E.L.M.A. have recently voluntarily revised their patent policy, which now, as stated in the Report, "goes well beyond the obligations placed on patentees by the law."

As well as dispelling these and other fallacious ideas, the Report makes it clear that the E.L.M.A. members have many solid achievements to their credit. Because of their efforts the country was self-sufficient in the production of all lamp components during the last war. That the resulting position was handled in a responsible way is made clear in

Next I.E.S. Sessional Meeting in London

The next I.E.S. Sessional Meeting in London will take place at the Royal Society of Arts, John Adam-street, W.C.2, at 6 p.m. on Tuesday, February 12.

At this meeting a paper entitled "The Specification and Testing of Fluorescent Lighting Fittings and Components" will be read by Mr. W. R. Bloxsidge, Mr. G. Fahey, and Mr. D. T. Waigh. These subjects are of great interest at the present time, and will no doubt give rise to a good discussion.

several paragraphs. A tribute is paid to a notable rise in lamp productivity during recent years, and a full reference is made to research, which is obviously very extensive, and it is made clear that the development of fluorescent lamps for general lighting was the work of an E.L.M.A. firm.

The Commission say they see considerable advantage in the exchange of technical knowledge within the industry, and much force in the argument that it could not continue if there were price competition between the companies concerned. Subject to certain safeguards, therefore, it is considered that E.L.M.A. members can continue fixing minimum prices for wholesalers, retailers, and users.

Other functions of the E.L.M.A., the value of which were appreciated by the Commission, include problems of lamp design and standardisation, technical and production problems, the exchange of technical and marketing experience, relations with other industries, including fittings makers and with government departments, scientific and technical bodies. Also mentioned in the Report are the well-known activities of the Lighting Service Bureau. It is understandable, therefore, that the Commission sees no sufficient reason why the E.L.M.A. should be completely broken up. The main changes which are recommended concern the availability of lamp components equally to members and non-members, the sales quota system, which should be discontinued, the removal of quantity and quality restrictions on Type B lamps, and the discontinuance of fines as a means of enforcing resale price maintenance.

From a recent answer to a Parliamentary question it appears that the Ministry of Supply will be responsible for discussing the recommendations with the members of E.L.M.A.; as we go to Press the result of the negotiations are not known, but it is apparent that some alterations in the trading methods of the E.L.M.A. firms are likely.

On the whole it would appear from the Report that in this country we have an enterprising and progressive lamp industry, and that the public obtains its electric lamps at prices which are "moderate in relation to costs."

Dow Prize Competition

On page 73 of this issue we give details of the Dow Prize Competition which has just been announced by the Council of the I.E.S. This competition, one of the objects of which is to bring lighting engineers and architects together in the early stages of their training, will receive every support from the lighting industry and it is to be hoped that it will lead in due course to a much better understanding between the two professions.

I.E.S. Summer Meeting

Details of the I.E.S. Summer Meeting which is taking place at Eastbourne from May 20 to 23 have now been circulated to all members of the Society. The programme of papers was announced some time ago, but the summaries of the papers given in the notice give a better idea of the scope of the meeting. The attractive and practical programme should result in a large attendance.

Lighting Education

A number of people wishing to take the final examination of the C. and G. in Illuminating Engineering must surely have been put off by the lack of a suitable textbook. This long-felt want has now been partially filled by a new book by Mr. W. R. Stevens entitled *Principles of Lighting* (Constable, 35s.) which will serve as a textbook for Section B. We will review the book shortly. As a footnote to his preface the author quotes Montaigne with "I have only made a nosegay of culled flowers, and have brought nothing of my own but the thread that ties them together." The thread in our opinion is pretty good.

Example of modern shop window lighting using louvres and adjustable spotlights.

Street Lighting in Germany

Little has been heard of street lighting developments in Germany, and the following article will be of great interest to street lighting engineers in view of the original approach which has been made to the problems of road surface brightness and glare.

By Dr. Ing. E. von der Trappen

After 1945 street lighting engineers in Germany were faced with the same problems as were their opposite numbers in England. They aimed at obtaining good visibility whilst at the same time keeping costs of installation, inspection and maintenance at a minimum; lighting fittings were required which would withstand all weather conditions; and light sources of very long life, to reduce maintenance costs; and high efficiency. These were considered in Germany to be the most important points needing attention.

The fluorescent lamp, with its high efficiency, useful shape and low brightness, was thought to have great possibilities in street lighting. In Germany, as is now the practice in many countries, endeavours are made to exploit the reflection properties of the road surface to obtain a high brightness and the fluorescent lamp would seem to be predestined for use in this connection. One application of these lamps, on the Weser Bridge at Bremen, giving a high road brightness, is shown in Fig. 1 where continuous lines of 40-watt lamps give an even and high brightness across and along the carriageway. This installation incorporates four lines each of eight 40-watt lamps. It is much more economical than the former tungsten lamp installation and gives much better results.

Fig. 2 shows, however, that it is not necessary to have a continuous line of lamps in order to light the whole thoroughfare satisfactorily with high brightness over the whole carriageway and good illumination

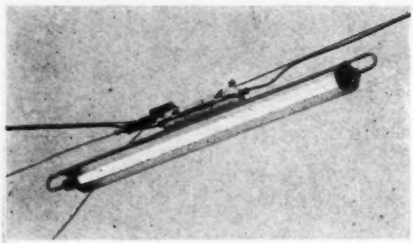
Fig. 1. *The lighting on the Weser Bridge at Berlin by means of lines of fluorescent lamps.*

of the houses bordering the street. The carriageway is 45 ft. wide and four single lamp fittings, each containing one 40-watt fluorescent lamp are mounted at a height of 30 ft. on span wires 120 ft. apart. One of the types of fitting used for such installations is shown in Fig. 3.

The first fluorescent street lighting lanterns made in Germany were all somewhat similar to the designs A1 and A2 shown in Fig. 4, with a number of horizontal lamps arranged vertically above one another in non-cut-off fittings. The enclosures were mainly of clear glass with perhaps a little diffusing glass; refracting glassware such as is in common use in England is hardly ever used in Germany. These lanterns are mounted at right-angles to the axis of the road, and radiate in both directions without diffusers; the total light output of a four-lamp lantern is about 8,000 lumens. Some local authorities have been persuaded that due to the high light output of these lanterns they could adopt long spacing and yet still obtain reasonable levels of illumination. This belief is, of course, quite wrong as the illumination falls abruptly from immediately beneath the lamp, and with this type of lantern only about 20-25 per cent. of the light output is usefully employed as against about 40 to 45 per cent. with the more common type of lantern using a tungsten lamp in a bowl refractor. Some other types of fluorescent lamp fittings are shown diagrammatically in Fig. 4 and representative fittings are shown in Figs. 5-9.

Reflectors directing light into angles between 65 and 75 deg. to the downward vertical would improve the uniformity of illumination; but this would increase the amount of light directed into the eyes of road users, giving a higher glare factor, which would impair the visibility. Increase of the total flux also increases the glare, and con-

Fig. 2 (*left*) *showing use of broken lines of light across the road using type of fluorescent lantern shown in Fig.* 3 (*below left*).



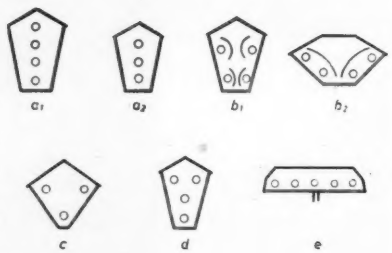
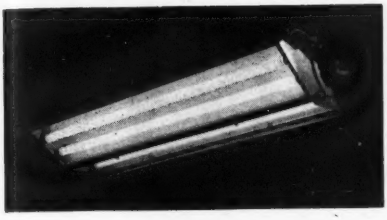
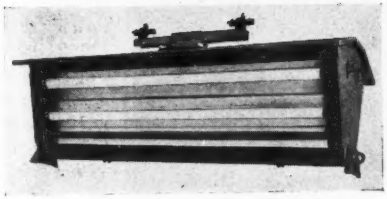
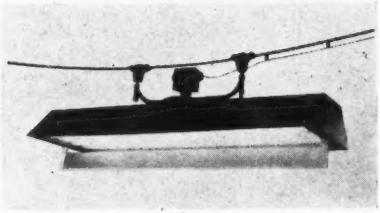
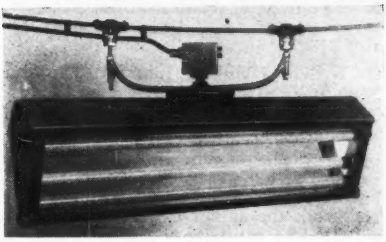


Fig. 4 (*below*). *Typical sections* (*diagrammatic*) *of the fluorescent street lighting fittings used in Germany.*









Figs. 5-9. Representative fluorescent street lighting fittings used in Germany.

centrating the light into higher angles will not achieve the desired result.

There are several other German designs using four fluorescent lamps; the only one using five lamps in V-formation is that shown in Fig 7. The cut-off fitting shown in Fig. 8 may have four or five 40-watt lamps arranged in a horizontal plane with a central vertical metal sheet beneath to produce the correct cut-off angle. The advantage of this arrangement is the attainment of a lower brightness than that of the bare lamps, but adequate carriageway brightness, and consequently a lower glare factor. The buildings are lighted to a height of about 22 ft. Spacings of not more than 75 ft. should be used, whether cut-off or diffusing fittings are used. Uniform high level lighting cannot be obtained with spacings greater than this.

Without doubt the method of attaining good visibility and high contrast of objects silhouetted against the road, exploiting the road reflection properties, has advantages. Comfortable seeing depends on the brightness of the lighting surface of the lantern, the brightness of the surrounding field, the angle of separation between the most nearly horizontal line of sight of the driver and the line from his eye to the lantern, and the solid angle subtended by the lighting surface of the lantern at the driver's eye. According to the formula given by Ward Harrison it is necessary to keep the brightness of the lantern to a minimum, since with fluorescent lamps the solid angle which it subtends cannot be small. In addition as the surround field, usually the dark sky, has a brightness of only about 0.01 foot-lambert, the brightness of the lantern must be kept as small as possible. The ratio of the brightness of a non-cut-off fluorescent lantern to that of its surround will be about 1,200 foot-lamberts to 0.01 foot-lambert or 120,000 : 1. Comfort in street lighting is probably unobtainable, as the ratio for comfortable seeing is given as 20 : 1. Even when the fitting is seen against

Fig. 10. Station - road, Dortmund. Each fitting contains four 40-watt fluorescent lamps at a mounting height of 30 ft. on span wires 130 ft. apart. The road is a main road without buildings on either side.

the wall of a building illuminated to about 2 lm./ft.^{2} and having a reflection factor of 30 per cent., the ratio will only be reduced to about 2,000 : 1, which is still too high.

It is obvious, therefore, that the best visibility conditions cannot be obtained by the use of bare fluorescent lamp lanterns. Neither is the author of the opinion that it will lead to satisfactory contrasts with the road surface. The surface brightness must be acceptable to drivers under both wet and dry conditions. When the road is wet the brightness will become glare which, though it may be reduced by the presence of lighted buildings, will distract the driver. In view of this, it would appear that the best results are to be obtained from fittings incorporating some form of diffuser.

Fig. 10 shows a main street in Dortmund, where two four-lamp 40-watt fittings similar to the types shown in Fig 4A are mounted on wires with a span of 135 ft. at a spacing of 120 ft., the first span seen in the illustration carrying three fittings. The result is not good, and it would have been better to have used more fittings with less lamps or fittings with a light source of twice the 3 ft. 6 in. length of the 40-watt lamps. Unfortunately, the 40-watt lamp is the longest one available in Germany. It is, however, interesting to note that the visibility is better when the road is wet than when it is dry, because there is less glare probably because the difference between the brightness of the fittings and that of the dry road surface is reduced, and partly because the size of the brighter parts of the field of view have been increased. The picture has obviously been taken on a dark, wet night; it shows the installation at its worst—but that is the condition which decides whether the installation is good or bad.

It would also seem that it is necessary to decide whether or not the use of fluorescent lamps is permissible on roads which have no bordering features, such as buildings, trees, fences, etc. No doubt

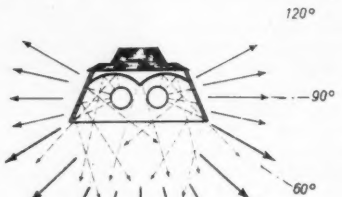


Fig. 11. Sketch of suggested inexpensive low brightness fluorescent fitting.

Fig. 12. *Installation at Siegen with 40-watt fluorescent lamps at a mounting height of 21 ft. on span wires with the lamps parallel with the axis of the road.*

there are some road users who are not troubled by the great differences in brightness between the fluorescent lantern and the dark sky or the not quite so dark road surface; but there are many who do find these conditions trying, and it is these who must be satisfied. It would seem from technical literature that in most countries fluorescent lamps are used with any form of diffuser. Consideration might be given to the use of a fitting such as that shown in Fig. 11, which has a brightness of about 500 foot-lamberts. Such a fitting would probably be cheap. The spacing on secondary roads and streets would need to be about 75 ft., but on main roads the spacing may have to be closer and/or two or three fittings used per span.

One of the principal objects of current experiments is to reduce the glare factor. It is not always practicable to do this by increasing the angle of separation, which can only be done by increasing mounting height or by wall mounting, as has been done at Eastbourne (see *Light and Lighting*, April, 1951). The only other way in which the glare factor with exposed fluorescent lamps can be reduced is by mounting the fittings parallel to the axis of the road. There are a number of such installations in Germany, and one, at Siegen, in Western Germany, is shown in Fig. 12. Here the fittings, which are of the reflector type shown in Fig. 3 with one 40-watt lamp in a reflector, are mounted at a height of 21 ft. at a spacing of 24 ft. The illumination under the lamps is 1 lm./ft.^{2}, and midway between the lamps is 0.55 lm./ft.^{2}. The width of the road is 45 ft., and the lowest illumination at the kerb is 0.15 lm./ft.^{2}. Though these values

Fig. 13. *Vertical fluorescent lamps on Nibelungen Bridge, at Regensburg.*

Fig. 14. *Fitting using* 40-*watt vertical fluorescent lamps in the station square at Bremen.*

are not a figure of merit for the installation, it is interesting to note that with a three-lamp fitting of the type shown in Fig. 4A2, and spaced at 90 ft. with the same mounting height, the illumination values would be 0.8 1m./ft.^{2} immediately beneath the fitting and 0.05 1m./ft.^{2} mid-way between the fittings.

Some towns have installed similar fittings in staggered arrangement with a mounting height of 15 ft. and spacings of 75 ft. for side-street lighting.

Two rather more decorative fittings are shown in Figs. 13 and 14. Fig. 13 shows the so-called "torch fittings" on the Nibelungen Bridge, at Regensburg. These each contain four 20-watt 2-ft. lamps and are mounted at 18 ft. opposite one another at a spacing of 75 ft. This is an ornamental installation, as is that shown in Fig. 14—containing 16 40-watt lamps; fittings of similar design but containing eight to 12 20-watt lamps are also available and are found to be most useful for lighting streets bordered by buildings.

The lighting of a subway under the railway at Dortmund is worthy of mention. As shown in Fig. 15, "light lines" have been

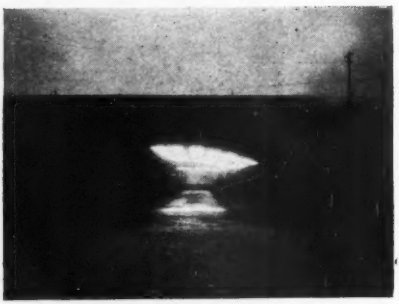


Fig. 15. *Showing the use of fluorescent lighting, under a railway bridge, made up of a number of lines of* 40-*watt fluorescent lamps.*

installed under the arch of the tunnel, each line being made up of 40-watt lamps, the lines being 30 ft. apart and an average of 12 ft. above the road surface. The main purpose of this installation was to improve conditions for drivers during the day rather than during the night.

It is doubtful whether the fluorescent lamp will altogether supersede other electric lamps or even gas lamps. About 55 per cent. of all the street lighting in Germany is by gas, and it is very common in the Ruhr. Bremen is entirely lighted by electricity, but 75 per cent. of the streets of Berlin are still lighted by gas. No doubt some of the gas lighting would have been replaced after the war but, apart from the fact that it is possible to light streets well by gas, in most cases the local authorities find it cheaper to rebuild their gas installations than to change over to electricity; moreover, gas is produced very cheaply in some of the industrial areas.

Blended light sources and high-pressure mercury lamps are also frequently used. Sodium lamps, in spite of their advantages, are seldom used, and though there were several installations before 1939, they have not been brought into service again. A fitting has recently been produced incorporating a cold cathode lamp.

Generally it may be said that cities like Hamburg, Bremen, Frankfurt, Cologne, Dusseldorf, Stuttgart, and Dortmund, have some good street lighting, but it will be a long time before all the streets and roads of those cities will be lighted to the standard necessary for the volume of traffic which they have to carry.

Recent Developments In Plant Irradiation

This article deals with recent work carried out at the John Innes Horticultural Institution on the growth of plants under artificial illumination and gives an indication of the commercial possibilities.

By A. CALVERT*

The article in the September, 1950, issue of *Light and Lighting* entitled "Lighting in Relation to Plant Growth," by Mr. K. J. Mitchell, was an excellent summary of the important work done in this field of research. The botanical aspects were fully dealt with and many references were given. It would therefore be superfluous to restate the basic principles involved in plant metabolism.

Recently at the John Innes Horticultural Institution an attempt has been made to ascertain whether artificial illumination has possibilities which would appeal to the commercial glasshouse grower as a means of increasing the efficiency of the production of glasshouse food crops, chiefly tomatoes.

Readers who are unfamiliar with horticultural practice will perhaps wonder why it should be considered advantageous to subject plants to artificial light when it is the practice to house plants in structures specially designed to transmit a large proportion of the natural light. It is, however, a fact that while during the summer months of the year, natural light is more than sufficient for the requirements of our plants, the winter months find the grower struggling to maintain healthy growth in the face of inadequate light conditions.

It is true that improvements in glasshouse design could help the grower considerably during these difficult periods, and the case for such improvement has been stated by Lawrence(1), but the fact still remains that, however efficient modern glasshouses are likely to be, the supplementing of natural light with artificial light of the right quality and quantity will bring about a highly desirable improvement in growth during the winter months.

The commercial grower, while realising the limitations placed upon him by nature, is not likely to be attracted to methods of illumination unless such methods have some affinity to commercial practice and the results show them to be sound from an economic standpoint. It will be seen that these considerations have been of vital importance in assessing the capabilities of the various lamps tested.

Incandescent lamps have proved quite unsuitable for the purpose of increasing plant growth because of the high proportion of heat emitted by these lamps. Plants subjected to this type of light become drawn and spindly. Young plants in this condition are unlikely to develop into strong, highly productive, mature plants. Because of this unfavourable response to incandescent light, little progress was made in this field of research until the introduction of the dicharge lamps.

Previous work on the plant's response to light from the various wave bands of the spectrum had been somewhat contradictory, though there appeared to be some agreement to the theory that maximum response came from the region of red light 6,200-7,200 Å with a secondary peak in the region of blue light 4,300-4,900 Å.

The work of Roodenburg and Zecher(2), when they used neon light with success on plants such as tomato, cumber, cineraria, etc., seemed to confirm this theory, but

* John Innes Horticultural Institution, Hertford.

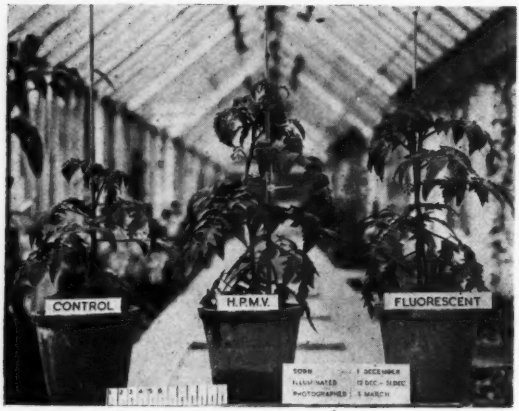


Fig. 1. *Showing response of tomatoes to artificial light.*

though it is almost 20 years since their work was published this method of plant irradiation does not appear to have been used to any great extent. It was thought that the answer to the problem lay in the use of light which had a rough approximation to daylight but was free from excessive heat radiation, and it was not surprising that fluorescent lighting appeared to offer excellent scope for this work.

Early experiments with fluorescent lamps at the John Innes Institution were concerned with the linking of plant response to light intensity, and it was found that for intensities within the range of 100 to 500 lumens per square foot, plant growth was in direct proportion to the number of lumen hours received by the plant. This information might give the impression that an accurate forecast of the plant's behaviour could be made, but this is not the case. It must be remembered that artificial light supplements the natural light and although artificial light will remain constant during the period of illumination, the natural light will vary with weather conditions and locality.

These experiments with fluorescent light were carried out with the aid of a plant irradiator which consisted of 14 5-ft. fluorescent "Daylight" tubes. The whole unit was mounted on a pulley rail which enabled the irradiator to be moved along the glasshouse bench from one batch of plants to another. The technique adopted was to place the plants beneath the irradiator soon after they had germinated and had been pricked-out into 3½-inch pots. At this stage the maximum number of plants could be treated. The plants received illumination for a period of 20 nights, the lights being switched on at dusk each day and illumination continuing into the night. This nightly period varied, with the experiments, from six hours to 10 hours, and the plants were cut off and weighed at the termination of the 20-night period.

In addition to ascertaining the light intensity-growth response, an estimation of the residual effects of illumination was obtained by continuing the growth of some tomato plants beyond the period of illumination to the fruiting stage. Table I shows the relative increase in crop over the various weeks of fruit picking which was obtained from plants grown at two illumination levels, namely 250 lm./ft.^{2} and 500 lm./ft.^{2}.

These results were very encouraging and showed that with the aid of artificial light the grower could, by sowing seed at the normal time, produce earlier tomato crops, or, by sowing later, reduce propagation time with a consequent saving in fuel and labour.

There was, however, one problem which had to be faced, and that concerned the method of application. It was obvious that the cumbersome nature of the equipment used constituted a very serious drawback to the method. The massing of fluorescent tubes over plants would mean a considerable amount of shade being cast on the plants during the daytime and, if the irradiator was not moved away during this period, the beneficial effects of the artificial light would be, to a large extent, offset by the loss of natural light. The necessity of having a movable irradiator also presented difficulties as to its mode of transport and the loss

Fig. 2. Showing response of cucumbers to artificial light.

of glasshouse space incurred by its "storage" during the daytime.

These difficulties caused attention to be turned to the possibility of using point, or rather "small" source light from the mercury and sodium vapour type lamps. If this were possible it was obvious that the more concentrated light source would obviate the necessity of removing the lamps during the daytime and a simplification of the equipment would mean a considerable saving in capital expenditure.

Lamps which appeared to offer the greatest possibilities were the high-pressure mercury vapour, "Dual" (mercury vapour and tungsten filament combined), and the sodium vapour lamps. All these lamps had the desirable characteristics of being compact in design, possessing a high lumens output and could be fitted into a comparatively small reflector.

It was of particular interest to discover what effect the sodium vapour lamp would have, as the wavelength emitted from this lamp is almost entirely confined to the orange-yellow region of the spectrum, giving, to all intents and purposes, monochromatic light. The high-pressure mercury vapour lamp, while having a broader wavelength emission than the sodium lamp, is deficient in the region of red light. The incorporation of a tungsten filament within the mercury lamp, as in the case of the "Dual" lamp would rectify the deficiency of red light, but would also increase the undesirable heat radiation.

As a result of several critical experiments made with these lamps it was found that the high-pressure mercury vapour lamp offered the greatest possibilities, growth being of excellent quality and generally in excess of that produced with either the "Dual" or the sodium vapour lamps. A typical result is shown in Table II.

The "Dual" lamp gave quite a creditable performance, but the presence of incandescent light caused the plants to become somewhat drawn. A further drawback is caused by the necessity of burning this lamp in a vertical position. It would appear that a greater lumens output can be achieved (for

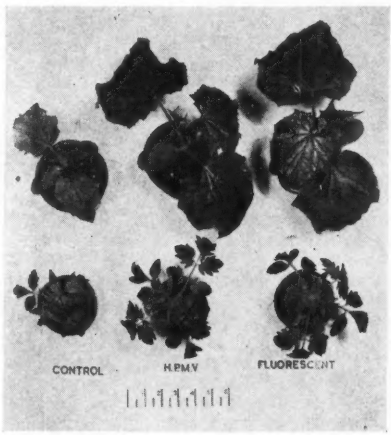


Fig. 3. Showing response of tomato and cucumbers immediately after the three-week period of artificial light.

the purpose of plant irradiation) by using lamps which can be operated in a horizontal position.

Though the sodium lamp produced the smallest response, it is interesting to note that by virtue of its low energy consumption a 140-watt lamp of this type shows a greater efficiency than a 400-watt high-pressure mercury vapour lamp if the figures are compared on a growth increase/wattage basis.

This is quite revealing in view of previous remarks regarding the wavelength characteristics of the sodium lamp, but it is difficult to see how this high luminous efficiency can be exploited. It might be that two sodium lamps feeding the same illumination area would give an equal or greater growth response than that produced by the use of one 400-watt high-pressure mercury vapour lamp, but any possible gain would be offset by the greater capital cost involved and the necessity of a larger reflector which would cut off a greater proportion of the natural light.

Having established the superiority of the mercury lamp over other point source types, there now remained the comparison with fluorescent light. Though there was a great physical dissimilarity between the two light sources, which made critical comparison extremely difficult, it soon became obvious that the effects were very similar. Growth habit and growth increase being almost identical at the same light intensities.

Table I

Relative increase in crop from Tomato plants under two illumination levels.

Variety : Potentate
Sown : 1st January
Planted : 14th February
Picking began : 26th May
Picking ended : 5th August

Relative yield of ripe fruit to end of :	Natural Light	Artificial Light (Fluorescent "Daylight" Tubes)	
		250 lm./ft.²	500 lm./ft.²
1st. week	100	205	233
2nd ,,	,,	184	192
3rd ,,	,,	155	175
4th ,,	,,	139	153
5th ,,	,,	131	143
6th ,,	,,	126	140
7th ,,	,,	124	136
8th ,,	,,	119	130
9th ,,	,,	116	124
10th ,,	,,	111	118
Total Crop (ripe and green fruit)	,,	108	116

Table II

Typical results obtained with different illuminants.

	Relative Weights	
	Tomato	Cucumber
Control	100	100
H.P.M.V.—400 watts	280	290
"Dual" —500 ,,	230	270
Sodium —140 ,,	200	250

Before leaving the subject of lamp comparison it should be stated that neon light was included in two of the trials. The results fully confirmed Roodenburg and Zecher's success with this light, though, as with fluorescent light, critical comparisons were difficult. While excellent response can be obtained from the use of neon light its application presents difficulties similar to those encountered with fluorescent tubes.

These experiments have made it possible for the horticulturalist to regard the artificial illumination of plants with greater interest, but it is by no means the end of the story. Having established which is the best light source there remains the problem of working out the best way to use these high-pressure mercury lamps. Work on this problem is proceeding both in this country and in the Netherlands, but because of the great number of factors which come into play it may be some time before a decision can be reached. Like the solving of a jig-saw puzzle, many pieces of interlocking evidence must be put together before the whole picture presents itself.

The first part of the problem concerns the period of illumination. Dutch workers are of the opinion that maximum response is to be obtained from illumination during the hours of daylight. This view may very well be correct, since it is well known that, within limits, the plant is able to utilise high light intensities more efficiently during periods of relatively high temperatures. However, in view of the fact that in this country, night-time illumination has given very appreciable increases in growth and because of the

necessity of making the fullest use of the lamps during a given time, it is felt that night-time illumination cannot be dispensed with. The obvious compromise is to illuminate two batches of plants simultaneously during 24 hours, the lamps being moved from one batch to another every 12 hours. This can be achieved quite simply by suspending the lamps from metal rails running across the glasshouse, and by sliding the lamps along the rails both sides of the glasshouses can be illuminated alternately.

The light intensity-temperature relationship is complex. The American plant physiologist, F. W. Went (3) has shown that growth response in tomatoes is at its maximum when the plants are subjected to diurnal variations of temperatures. It is unfortunate (for horticulture in this country) that the bulk of Went's evidence refers to American varieties of tomatoes, which, in many respects, differ from varieties grown in this country. Data regarding the thermo-periodicity of British varieties of tomatoes would be more than welcome and would greatly assist in solving many of the problems concerned with the irradiation of plants. However, the results of trials now in progress may help considerably in the understanding of the plant's temperature requirements.

Another aspect which is not fully understood concerns the behaviour of tomatoes when subjected to certain light periods. In an early experiment with fluorescent light, when the artificial light period consisted of only five hours in the middle of the night (the light period separated two periods of darkness) abnormalities in plant growth occurred. These consisted of chlorotic patches on the leaves and a distortion of the distal leaflets. It seemed that the tomato plant required an optimum dark period if development was to continue on normal lines. Withrow and Withrow(4) have stated that normal growth could be expected from tomatoes receiving up to 18 hours' continuous light, but increases beyond this total light period would bring about varying degrees of chlorosis, culminating in complete chlorosis at 24 hours.

Limiting the total period of illumination to 18 hours a day does not solve other problems in tomato. For example, assuming that the tomato plant needs a main dark period of not less than six hours, do short dark periods of half-hour, one hour or two hours, which are subsidiary to the main dark period cause these abnormalities? Does the term "dark" refer to total darkness, or would a modicum of light equate with darkness? Do the principles apply under all conditions, e.g., all light intensities? Until these questions are answered, progress must be cautious.

Despite our ignorance on these matters, results to date have been sufficiently promising to warrant the recommendation of tests on a small scale under commercial conditions, and it is hoped that a few will be carried out this winter. This is most desirable, as so much depends on the grower dovetailing this new method into his existing practice so that the requirements peculiar to his conditions and locality are satisfied.

The problems enumerated above are the concern of the research worker. There are, however, other problems which are the exclusive concern of the grower, since it is impossible to formulate a complete programme of cultivations which can have universal application. This is of particular significance in the case of deciding how early artificial illumination can be commenced. As in the John Innes method the plants are subjected to illumination for only the first three weeks of their lives, the subsequent natural light intensity is of vital importance to the future development of the plants. Poor light not only causes poor growth, but also severely limits the plant in its ability to set fruit, and in extreme cases may result in the abortion of the whole flower truss. To bring the plants to the flowering stage when natural light intensities are at their lowest may be undesirable and uneconomical, but to avoid this, it is for the grower to decide on the timing of operations, knowing as he does his own conditions and the limitations which they impose.

To summarise: the technique likely to be adopted in the immediate future is as follows. High-pressure mercury vapour lamps (400 watts) suspended about 3 ft. above the glasshouse bench and spaced 4 ft. apart illuminate young seedlings for about three weeks, commencing when the seedlings are two or three days old from germination. The period of three weeks is adopted because at the end of that period the plants will most probably have reached a stage when spacing-out is desirable. Should this stage not be reached at the end of three weeks there appears no reason why illumination should not be continued until spacing is necessary.

The lamps can be either fixed, illuminating one bench only, or movable, so as to illuminate both sides of the glasshouse alternately. Growth response will be closely related to total lumen hours; therefore the

(Continued on page 59)

Hospital Ward Lighting

This article gives a general description of the investigations on the lighting of hospitals which are being carried out at the B.R.S. Detailed descriptions of the experiments will be given in a later issue.

By D. J. PETTY,*
M.B.E., M.A., A.R.I.B.A.

Introduction

The Nuffield Provincial Hospitals Trust, at the suggestion of its Secretary, Mr. Farrer-Brown, set up early in 1949 an Investigation into the Functions and Design of Hospitals. It is sponsored jointly by the Trust and Bristol University. The Investigation team includes the director and architect, a doctor, a nurse, an historian, a field work organiser, and an accountant, and they are assisted by a staff of architects, time study engineers, and research workers. The object of the Investigation is to produce a report designed to help those authorities and architects concerned with the provision of hospital services. This report will be issued about the end of 1952.

A panel of expert advisers, composed of men and women eminent in medicine, nursing, architecture, and the social sciences, is available to advise the team. The Investigators also co-operate with other bodies in certain fields, for example, the problems of heating, lighting, ventilation and fire protection are being studied at the Building Research Station.

In co-operation with the Investigation, research into the daylighting of hospital wards has been carried out at the Building Research Station. The present article deals with the problem of daylighting for a particular ward and gives the broad results of the research.

Daylighting Studies

The first problem studied by the Investigation was the hospital ward. Studies were made into the organisation and running of wards, and as a result of these studies a compact ward plan was designed to give economies in building and running costs. The ward is on the "Rigs" layout (i.e., with beds parallel to the outside wall), with two beds deep either side of a central circulation area. This plan resulted in a building 43 ft. 4 in. wide, and the problem was whether adequate and comfortable conditions of lighting could be achieved with a maximum ceiling height of 12 ft.

It is not difficult to provide adequate light into the centre of such a wide building if the ceiling height and size of windows is unrestricted. Increase of ceiling height,

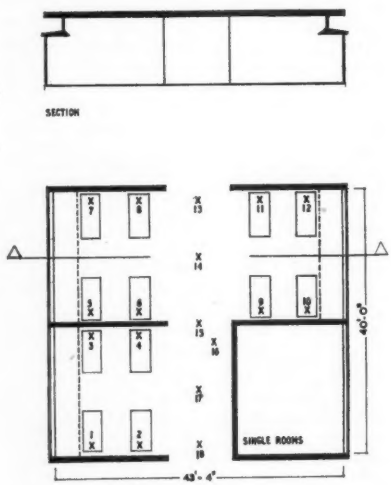


Fig. 1. *Plan and section of the experimental ward described in this article.*

* Research Architect : Investigation into the Functions and Design of Hospitals.

however, costs money, not only in first building costs but also in heating and maintenance. A large window may be very uncomfortable, especially to a patient lying in bed near to it. A patient in bed is particularly susceptible to glare as he is in a fixed position. While the problem of glare for patients on the "Rigs" layout may not be so critical as for patients in the traditional English ward where they lie opposite a row of tall windows, in this case light is required in the centre of a thick building, the design of the window is important.

The sky factors for the ward with 10- and 12-ft. ceiling heights were calculated. It was found that with windows the full width and height of the outside wall, and no window bars, the sky factors in the centre of the building, at position 14 (see Figure 1) were 2.0 and 3.2 with 10-ft., and 12-ft. ceilings respectively, at position 17, 1.0 and 1.7 respectively, and for the inside beds, e.g., position 2, 2.1 and 3.2. These figures implied that with a ceiling height of 12 ft. there would be enough direct light, but that it was doubtful with ceilings of less height.

The sky factor* takes no account of the light reflected from the ground outside nor from the surfaces within a room, and it was felt that a more accurate picture was required of the lighting to be expected in such a building. It is difficult to calculate the daylight factors† for a given set of conditions, and it was therefore decided to build a model in which to study the daylight factor distribution in relation to ceiling height and window design.

Illumination, particularly natural illumination, can be very conveniently studied using models, as light transmission and reflection are dimensionless.

Measurements of illumination were made at a number of significant points throughout the ward, using selenium rectifier photocells.

The wide building and the comparatively low ceiling raise several design problems. As will be seen from Figure 1, most of the beds have windows on two sides which would be visible whichever way patients turn. The patients in the beds nearest the windows have a very large view of the sky, whilst the patients in the inner beds would have direct light coming at a low angle. Both these features are undesirable. It is generally considered that the angle of direct light incident on the working plane should be greater than 20 deg.-25 deg., and although this holds primarily for tasks involving critical seeing, it seems undesirable, from this consideration alone, for the ceiling height in the ward to be less than 10 feet. The problem of the sky view is less easy to decide. Large windows are necessary to permit adequate amounts of light to enter, and the discomfort glare from such large windows can be reduced only by provision of suitable blinds or louvres to cut out the patient's direct view of the sky.

Several window designs were considered to decide which was best to be tried out in the model. The design had to be such that it would admit adequate light to the centre of the building, yet provide a reduction of light for the outside beds.

It was decided that the design with the baffle (Figure 1) was worth trying in the model, provided that the inside edge of the baffle was tapered to receive light and thus reduce an otherwise harsh contrast. It is not claimed that the baffle design is the only possible one, for there are other methods of providing control of the light. The baffle had the advantage of reducing the area of sky seen by the outer bed, and also it was hoped that it would help to distribute light more evenly throughout the rooms, but from the results obtained it has not been so effective in this latter respect as was first supposed.

It was considered that screens fixed near bed would provide a way of obscuring the direct view of the window for the patient without cutting off too much light from the rest of the ward. Curtains were required round the beds for other reasons, and it has been decided that provided they are light in colour these will be adequate protection for the patient.

Several conclusions may be drawn of the contribution of reflecting surfaces to the daylight factor:—

(a) Provided that the average reflection factor of the walls, ceiling and floor is high, the ward acts as a very efficient integrator of light, and, except in a few special cases, the contribution of any one wall is small at points other than those in its immediate vicinity. Thus there is considerable scope for the

* The Sky Factor at a given point inside a building is the ratio of the illumination on a horizontal plane due to the light received directly from the sky to the illumination due to an unobstructed hemisphere or sky of uniform luminance to that of the visible sky. This ratio is a geometrical property of the building design, and as such it does not include light reflected from the ground outside or from wall surfaces within the room. It may thus be considerably lower than the measured daylight factor, and is calculated to enable an assessment of the probable daylighting conditions to be made before the building is constructed.

† The Daylight Factor, measured at a point in a room, is defined as the indoor illumination on a horizontal plane, expressed as a percentage of that simultaneously obtained out of doors, under a completely unobstructed hemisphere of sky, the effects of direct sunshine being excluded.

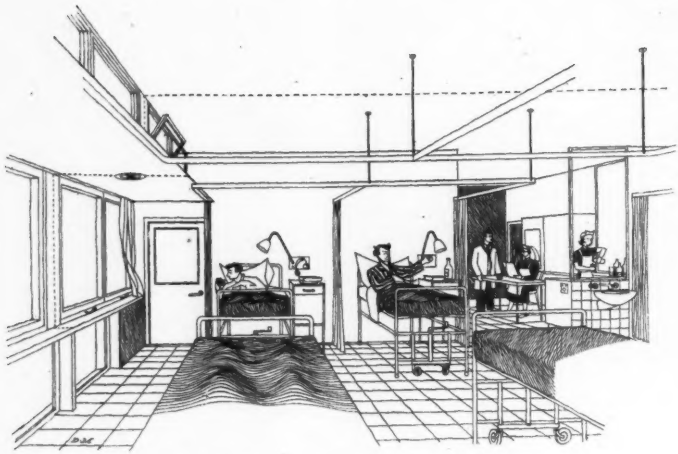


Fig. 2. Patients' eye-view of the ward.

design of colourful schemes of decoration, if these are considered as a whole and if the average reflection factor of the scheme is maintained comparatively high.

(b) Alternatively, if the average reflection factor of the walls, ceiling and floor is low the contribution of any one wall, even if of a very high reflection factor, will be small at points other than those in its immediate vicinity; where, moreover, it will be much smaller than might be expected.

(c) The scope for the design of colour schemes becomes more restricted as the ceiling height is reduced, because then the proportional contribution of each wall to the total illumination becomes increasingly greater.

(d) The contribution of the floor and ceiling are very considerable, and it is important to regard both, and in particular the floor, as essential parts of any scheme of decoration. It will be appreciated that the ceiling derives much of its illumination from the floor, and the two should therefore be considered together. The floor and the lower parts of the walls should be finished in as light a colour as possible, if full value is to be obtained from a ceiling of very high reflection factor,

(e) The reflection factor of the ground outside the ward has a considerable influence on the interior lighting. The ceiling receives light from the sky by reflection from the ground outside. If this ground is dark, the ceiling will receive less light than if it is of high reflection factor.

This paper shows that the use of the sky factor to indicate the possible level of illumination in a building will provide a considerable factor of safety.

The daylight factor in the ward considered can be as much as five times the sky factor with light-coloured internal surfaces, and the conclusion drawn is that the sky factor gives a measure of the interior illumination only in cases where the internal surfaces are dark. The Building Research Station is investigating the possibility of evolving some simple formulæ or graph which can estimate, more accurately than the sky factor, the possible illumination with various building widths, ceiling heights, and reflection factors.

An experimental ward designed by the Investigation into the Functions and Design of Hospitals is being built by the Department of Health for Scotland at the Larkfield Hospital, Greenock. The Experimental Ward Unit will incorporate the baffle in the window design, measurements of the amount of light will be recorded and compared with those measured in the model studies.

Artificial Lighting

There are two problems in lighting a hospital ward, first the general illumination, and secondly the bedside lighting. The general illumination should be adequate to allow the staff to carry out their tasks easily,

as well as permitting them to see their patients. This has to be done without causing discomfort to the patients in bed. In terms of lighting requirements this means a well-lit ceiling, a well-lit area between the feet of the beds, and contrast grading the fitting so as to avoid discomfort to the patients.

The lighting at the bedside is primarily for the use of the patient. Therefore the fitting must be easily controlled by the patient so that he can direct the light where required. The illumination must be adequate for the requirements of the patient yet not too bright to cause discomfort to the other patients.

The light fittings that meet the requirements of the general illumination and of the bedside lighting need not be specialised hospital fittings but they should be easy to clean and reasonable in price. The question of price is important as hospitals have to keep their expenditure within a limited budget and the extent of the service they provide is limited by cost. Therefore, if the standard of lighting of hospitals is to improve, the price of the light fittings must be reasonable. There should be a large market for the right type of fittings if they were available.

Acknowledgement

The work described in this article was carried out at the Building Research Station and is published with permission of the director. It forms part of the joint programme being carried out by the Building Research Station and the Investigation into the Functions and Design of Hospitals, sponsored by the Nuffield Provincial Hospitals Trust and the University of Bristol.

Recent Developments in Plant Irradiation

(Continued from page 55)

greatest number of illumination hours per day should be attempted, but a maximum of 18 hours' total light should not be exceeded.

The date of sowing tomatoes requires careful consideration in the light of local conditions, and cultivations throughout should be of the highest possible standard.

While this article has laid particular emphasis on the illumination of tomato plants, since they constitute the major glasshouse crop in this country, there is reason to believe that other crops can, with benefit, be treated with mercury lamps. In addition to showing the response of tomato, Table II shows an equally impressive result in the case of cucumber. The technique of irradiating cucumbers is substantially the same as that for tomatoes.

Since excellent results have been obtained with plants of such dissimilar characteristics as tomatoes and cucumbers, it is reasonable to assume that many other types of plants will benefit from illumination. This would not only mean that a new tool would be at the disposal of the commercial grower, but that a new instrument would be available to botanical research.

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I.E.S. Notices

Lamp-works Visit

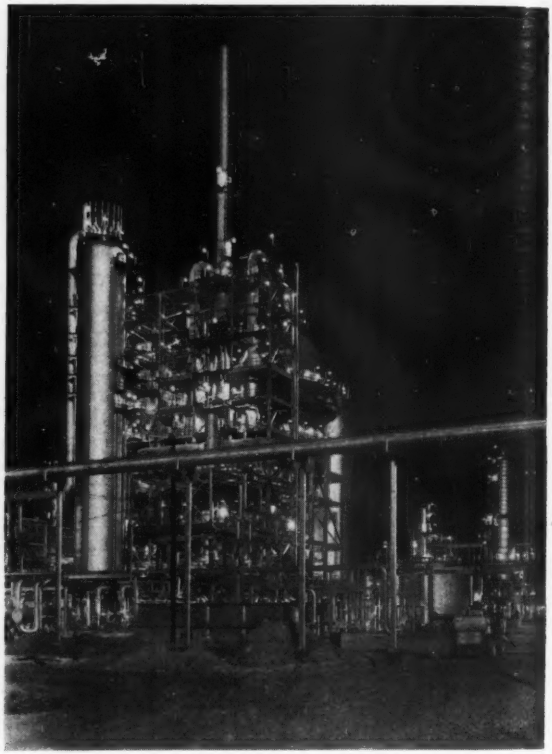
A visit to the Osram Lamp Works at Eastlane, Wembley, will take place on Wednesday, February 27. The visit is open to all members of the I.E.S. and those wishing to take part should communicate with the I.E.S. Secretary at 32, Victoria-street.

Brains Trust Meeting in London

A year or two ago a most successful Brains Trust meeting was held in London when the Question Master was Mr. Kenneth Horne. A further similar meeting has been arranged for Wednesday, March 26, and once again Mr. Horne has agreed to keep the team in order. The members of the team on this occasion will be Mr. E. C. Lennox (North Eastern Electricity Board), Mr. S. S. Beggs (G.E.C. Research Labs.), Mr. C. W. M. Phillips (B.T.H. Co.), and Mr. L. G. Applebee (Strand Electric).

Members wishing to submit questions should send them to the I.E.S. Secretary; questions should be on debatable matters and not on matters of fact.

The New Fawley Refinery



This article describes the interior and exterior lighting of the Fawley oil refinery, the largest in Europe, and certainly one of the most ambitious post-war constructional projects in this country.

A permanent staff of some 2,200 are employed at the new Fawley refinery of the Esso Petroleum Co., Ltd., the largest oil refinery in Europe. Many new buildings were erected at Fawley at the same time as the refinery installations themselves, to house the administrative offices, laboratories and social facilities for this new population.

The administration building has a floor area of 64,000 sq. ft., four times that of the Albert Hall. Detailed studies of alternative lighting schemes and comparisons of running costs were made by engineers of the G.E.C. illuminating engineering department in collaboration with the architects, Messrs. Lanchester and Lodge, before construction began. All offices consist of one or more bays, 12 ft. wide by either 15 ft. or 28 ft. long. The arrangement adopted in most cases consists of three 5-ft. 80-watt fluorescent fittings in each bay, two placed longitudinally and one transversely. Illumination values average 25 lm./ft.^{2}, although higher levels are provided in some places, for example 35 lm./ft.^{2} in the mechanical engineering drawing office, and 32 lm./ft.^{2} in the machine accounting section.

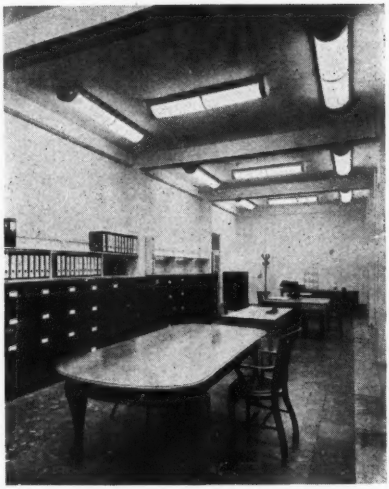
A uniform pattern of fitting has been used throughout the block. This is a decorative unit with a cream stone-enamelled sheet metal body and a fluted glass enclosure for the lamps. Most of the 448 fittings of this type in the building are for two lamps, but the design is arranged so that when only one lamp is required, as in certain rooms, the fitting can be adapted easily to take a second lamp if it is decided to increase the illumination at a later date.

Most of the fittings are ceiling-mounted, but where the height of the ceiling makes suspensions necessary the same pattern is used with a top canopy for attachment to

the suspension rods. All 5-ft. lamps in the building are on instant-start circuits. A standard G.E.C. fitting for a 3-ft. 30-watt lamp has been used for all corridor lighting. Its style harmonises with the special fittings elsewhere in the building, the lamp enclosure being a tubular bend of clear, reeded "Perspex" secured by simple decorative end caps.

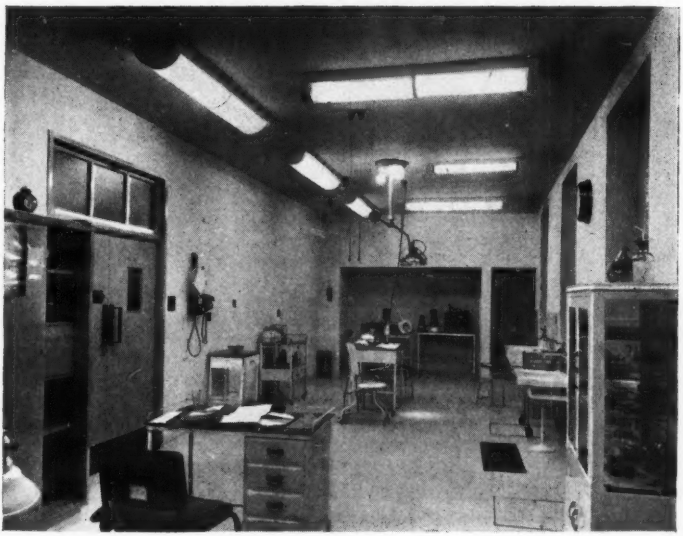
In the laboratories general lighting is provided by twin-lamp opal "Perspex" trough reflectors, except in certain rooms where tungsten flameproof fittings are installed. A special scheme was devised for lighting fume cupboards, for which some 40 fittings were made. Each consists of a Gecoray reflector and 100-watt lamp inside a box shaped to slide into the top of the cupboard, where it is located by clips so that the reflector is above a well glass let into the cupboard's false ceiling. The unit therefore can be withdrawn for maintenance without disturbing the well glass.

The same type of 3-ft. 30-watt fitting is used in the laboratory corridors as in the administration building. Twin-lamp opal "Perspex" trough reflectors are also installed in the administrative offices of the Dockmaster's building and in the timekeeper's office, where the time clocks are lighted by tungsten lamps in dispersive reflectors. Some flameproof tungsten fittings have been supplied for certain situations in the Dockmaster's building.



5-ft. 80-watt lamps light this conference room in the administration block.

A new clubhouse available for employees and their families has been built near the



View of part of the medical wing where the general lighting is by 5-ft. 80-watt fluorescent lamps.

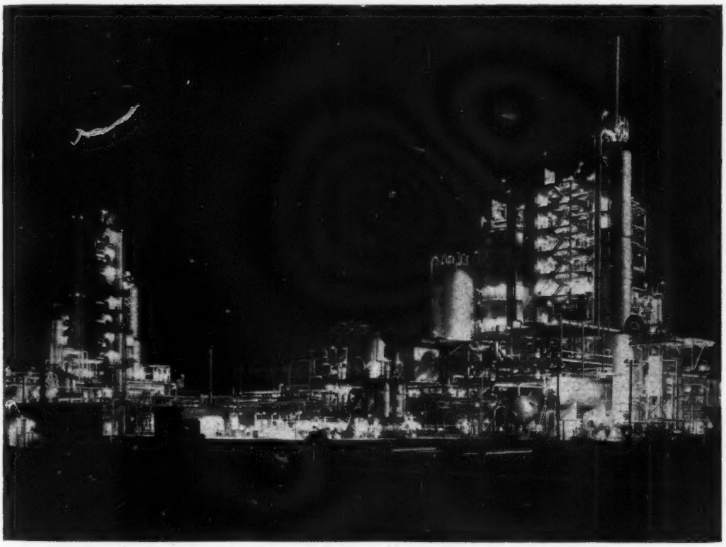
Lighting in the control room.

refinery site. It includes a main hall and cinema with semi-indirect lighting from 5-ft. 80-watt lamps in twin-lamp fittings mounted end to end in a cornice behind champagne colour glass. The glazing bands are arranged to coincide with the ends of the

Night-time view of the refinery.

fittings so that the whole of the glass itself is evenly illuminated. Ten special decorative wall brackets for 200-watt tungsten lamps were designed for supplementary lighting. Decorative enclosed tungsten fittings of various designs are used in other rooms of the social club, and the games room, with table tennis and dart boards, is lighted by twin-lamp fluorescent fittings with individual tubular "Perspex" enclosures for the lamps.

The electrical contractors for all the interior lighting except that in the Dockmaster's office were Messrs. T. Clarke and Co., Ltd. The Dockmaster's office lighting was installed by Foster, Wheeler, Ltd.



View of the jetties illuminated by 500-1,000-watt projector lamps.

Exterior Lighting

The exterior lighting is in accordance with American practice in which the plant is divided into hazardous, non-hazardous and safe areas. At Fawley all these are equipped with Metrovick lighting equipment. In the hazardous areas, flameproof type lighting equipment is used. Vapour tight equipment is used in the non-hazardous areas.

Over 1,700 100/200-watt vapourtight well glass units have been used mainly for exterior lighting in the non-hazardous areas on the plant itself. These fittings have a conical cast aluminium top, vitreous enamelled steel reflector and galvanised wire guard. Special gauge glass fittings were developed for this installation and over 600 are in use throughout the non-hazardous areas. They consist of a silicon aluminium conduit box to which is fixed a cast lamp housing for two 25-watt tubular lamps. The recessed glass panel is curved and lightly frosted on the inside.

One hundred and eighty floodlights have been used for lighting the jetties, separators and other similar locations throughout the plant. The floodlights are of cast silicon aluminium alloy for 500/1,000-watt B2 projector lamps.

Other equipment includes "Trafford" street lighting lanterns for general road lighting; control room and boiler-house lighting fittings to make a total of some 3,000 fittings.

Acknowledgment is made to the Esso Petroleum Co., Ltd., for permission to publish the photographs of the control room and medical wing.

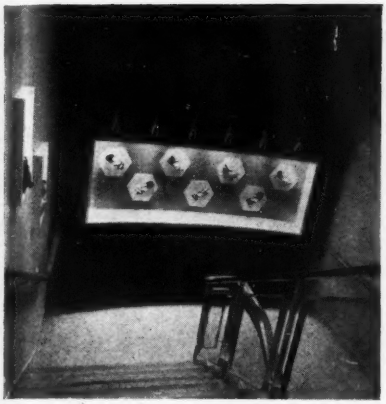
Dolcis Shop, Plymouth

In this new store, one of the first to be completed within the new town planning scheme, extensive use has been made of false ceilings creating varying levels, and lighting engineers were consulted at an early stage in the design so that the lighting installation formed an integral part of the shopfitting work.

Lighting has been used as a lead-in, to punctuate various selling areas, and to obtain high brightness for displays. Cold cathode lighting has been used extensively to light the various cornice and coffers on the ground floor. A notable feature is the glass wall which terminates the vista from the entrance. This consists of a wall constructed entirely of glass bricks, in the centre of which has been fitted a showcase illuminated on all sides by cold cathode tubes shining through translucent panels.

Special attention was given to the children's department on the first floor. This was designed throughout with a train motif; a mock-up of a railway carriage forms the major display case. This case is illuminated by means of a coloured cycloramic

Showing illuminated showcase set in a glass brick wall. This forms an important focal feature of the entrance vista.



Staircase display, illuminated by 150-w. internally silvered spotlights.

background utilising fluorescent lamps. High brightness on the merchandise is obtained by means of internally silvered lamps. General lighting in this department is by means of a patterned system of semi-recessed "Hyliters."

The main staircase linking various floors has been lit entirely by spilt light coming from the showcases mounted on each half landing. These showcases are illuminated by means of double-skinned "Hyliters" with 150-w. internally silvered lamps. Additional stair lighting is obtained from the small showcases which form a "stepped pattern" along the wall.

Lighting of the second floor is achieved by means of large egg-crate sections recessed into the ceiling and lit with fluorescent lamps, these egg-crates forming the basis for a pattern of recessed "Hyliters" throughout the main selling area, thereby ensuring a good degree of colour discrimination. Another notable feature of this department is the way in which the architect has made the ceiling appear to float off the wall. This was achieved by forming a recess in which was housed a continuous line of cold cathode tubing.

The main name sign on the fascia consists of special style block lettering in stove-enamelled sheet steel illuminated by white fluorescent tubing on the face with blue fluorescent tubing behind.

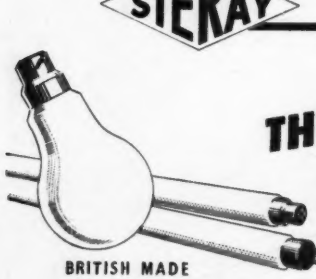
Black-and-white photographs do not do justice to this extremely interesting building. The whole interiors are a mass of colour and light, and full marks must be given to the architect who has helped to give the Plymouth Town Planning Scheme such an interesting send-off.

The architect was Ellis E. Somake, F.R.I.B.A., staff architect to Messrs. Upsons, Limited, and the lighting specialists were Courtney, Pope (Electrical), Limited.

Lighting in the second-floor department by recessed spotlights and egg-crate louvres.

HIGHLIGHTS OF THE LIGHTING WORLD

SIEMENS
SIERAY
STREET LIGHTING
for road safety



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BRITISH MADE

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Branches at Belfast, Birmingham, Bristol, Cardiff, Dublin, Glasgow, Leeds, Liverpool, Manchester, Newcastle-on-Tyne, Nottingham, Sheffield.

Correspondence

Street Lighting

To the Editor, LIGHT AND LIGHTING

Sir,—May we be permitted to comment on the article entitled "Lamps for Street Lighting" by A. G. Penny and F. J. G. Clack in the November issue?

The authors, in their references to fluorescent lamps, make a number of statements which, although in themselves rather vague, give the impression that they are facing both ways on the question of longer lives. For example, they say that "The time for which a fluorescent lamp will operate . . . may easily be made to be many thousands of hours" and lower down in the same paragraph suggest that the problem had to be left until good lumen maintenance was achieved and that then took several years to solve. Apart from the inconsistency of the argument a somewhat parochial outlook is shown, in view of the fact that a life of 7,500 hours (three-hour cycle) has been achieved in the United States for the past three years, and was declared at a time when zinc beryllium silicate phosphors were in general use. Further, the lumen maintenance of American four-foot 40-watt lamps made five years ago was better than that stated in the article.

The argument, based on the figure of 35 per cent. loss of light output in three months due to dirt alone, is interesting, particularly the reference to group replacement at 3,500 hours. In order to operate such a scheme we must assume that a considerable proportion, say 80 per cent., of the lamps are in lighting at the replacement time, viz, 3,500 hours. For this to happen the lamps in the installation must have a natural average life of 4,500 hours or more. Group replacement has little meaning if a smaller percentage of the original lamps is still in lighting.

While we are in general agreement that group replacement is desirable, not only in street-lighting, but in other large installations, we feel that longer average lives than those previously produced by the lamp engineers are necessary in order that group replacement may be of value to the user.

It should also be borne in mind that 35 per cent. loss due to dirt is above average for the majority of locations, even for street-lighting lanterns, whereas for the more common applications of fluorescent lamps, figures as low as 3 per cent. have been recorded.

No reference is made to the "midnight switching" mentioned by Mr. H. E. Watts in the article entitled "Fluorescent Street Lighting—First Five Years." It would appear to complicate the question of group replacement somewhat, in view of the different operating periods of the one lamp left running all night and the remainder. The conclusions drawn from Figure 1 are clearly not directly applicable in this case. Are the "all-night" lamps to be treated as a separate installation for the purposes of group replacement, or are they to be replaced when the others have rached 3,500 hours? In the latter case they would need to last 7,000 hours or longer.—Yours, etc.,

D. T. WAIGH.
G. FAHEY.

London.

High Elevation Lighting

To the Editor, LIGHT AND LIGHTING

Sir,—I was interested to read in the December issue of LIGHT AND LIGHTING of the lighting in the new Abbey Works of the Steel Company of Wales, and especially of the external lighting by means of projectors mounted on exceptionally high towers.

Having seen the installation I feel that the comments in the article hardly do justice to the unusual effect of this high elevation lighting. It is true that it minimises dark shadows and to a large extent avoids glare, but these remarks do not give much idea of the extra *comfort in seeing* due to the lighting coming from on high. There have in the past been many attempts at flood-lighting large areas by batteries of projectors mounted on fairly high masts, but these have generally lost much of their value owing to the discomfort glare they produce because the projectors are in the line of sight. It appears that designers have concentrated simply on getting so many foot-candles at ground level instead of considering the problem of *seeing* in the broadest sense. In my view the lighting of large areas from really high towers has shown that in this realm, as we have lately come to realise in so many other fields, the science of seeing involves much more than mere quantity of light.—Yours, etc.,

ARTHUR CUNNINGTON.

Pulborough, Sussex.

New Lighting Installations

A Cloth Showroom

When Messrs. Dormeuil Freres, a leading West End firm of woollen merchants, decided on a new showroom at their Warwick-street premises they were faced with the problem of exhibiting some thousands of cloth patterns in the limited space at their disposal, and they devised for themselves an ingenious arrangement of hinged frames carrying samples of cloth on each side.

These frames are mounted vertically in two sections in a specially formed recess some 20 ft. long, the whole resembling two extended "books" standing on end with the "bindings" against the wall. Customers are thus able to examine a wide range of classified patterns simply by turning the "pages" of the book.

The lighting problem here was to provide shadow-free illumination of a completely uniform intensity on every frame and this has been successfully accomplished by the use of one row of 5-ft. 80-watt fluorescent lamps behind a shallow canopy at the front edge of the frames.

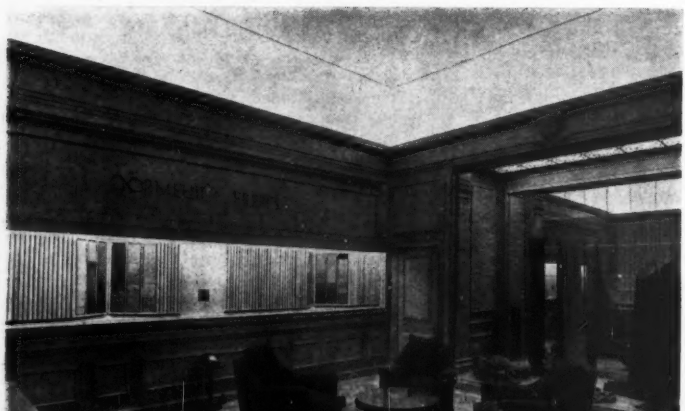
In addition to this rather novel form of presentation the showroom has a more orthodox display stage where dual purpose lighting is provided.

This is in the form of separately controlled Siemens colour matching blue fluorescent lamps and warm white fluorescent lamps above an ornamental metal grille over the stage.

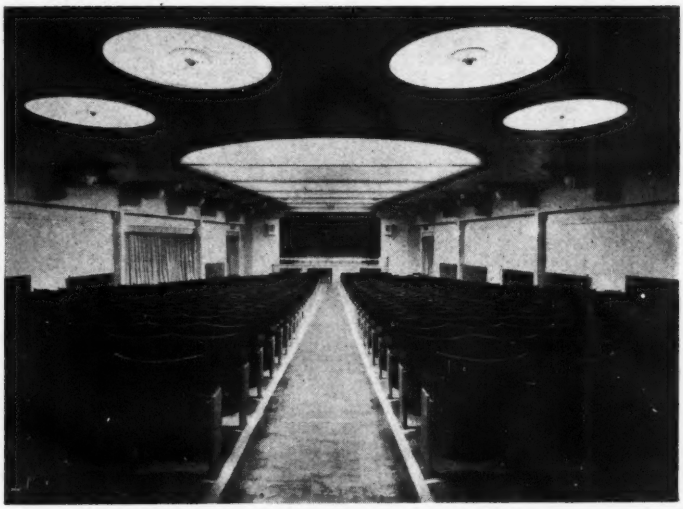
A specially constructed cornice accommodates a continuous row of 5-ft. 80-watt fluorescent lamps with overlapped ends to provide the general lighting for the showroom and the effect of this indirect lighting is to focus attention on the pattern display, which is, of course, the primary purpose of the showroom.

This arrangement provides an example of the value of brightness contrast in display lighting and since the period of vision is unlikely to be protracted a relatively high degree of contrast is permissible without risk of discomfort.

Accurate colour rendering is not regarded as of great importance for the general lighting and consideration may be given at a later date to the use of warm white lamps



Lighting of a cloth showroom by 5-ft. 80-watt fluorescent lamps.



Tungsten and cold cathode lighting in the redecorated Esplanade Theatre, Bognor Regis.

for the winter season and "natural" lamps for summer use when perhaps the illusion of a cooler atmosphere may be appreciated.

The lighting was designed by the Illuminating Engineering Department of Siemens Electric Lamps and Supplies, Limited, and installed by Messrs. Druce and Co., Ltd., Baker-street, London, W.1.

A Theatre

Interior redecoration at the Esplanade Theatre, Bognor Regis, was completed in time for the winter season. Various features have been introduced in the reconstruction to permit the installation of a decorative lighting scheme designed by The G.E.C., Ltd., in conjunction with the Bognor Regis U.D.C. Engineer and Surveyor, Mr. H. H. Evans.

At the front of the hall the false ceiling is cut away in a horseshoe shape, outlined by a cornice containing a triple run of cold cathode tubes for indirect illumination. Two lines of tubing are Warm White and one Gold, and each colour is on a separate dimming circuit. Five roof girders crossing the horseshoe are encased in plaster, and a false ceiling at a higher level than that in the remainder of the hall conceals the rest of the roof construction in this area. This part of the installation uses 332 ft. of Warm White tubing and 166 ft. of Gold.

Over the rear part of the hall four domes, 7 ft. in diameter, have been formed in the false ceiling. Each is illuminated by an Anolier containing a 200-watt tungsten lamp. The lamp is housed in a polished aluminium cup, above which is a cream-colour circular spinning arranged so that its underside is illuminated. Most of the light, however, is reflected from the interior surface of the dome, which is coloured pale blue. All the dome lighting is on its own dimming circuit.

In addition to these fluorescent and tungsten indirect lighting schemes, the hall has supplementary direct lighting from two-lamp wall brackets with coloured semi-circular "Perspex" enclosures and gilt-finished metalwork. The 60-watt lamps in the brackets are on an independent dimmer circuit, so that the dimming possibilities in the hall are very flexible, controlling both the level of illumination and, through the cold cathode circuits, the colour of the light.

The electrical installation in the hall was carried out by the Southern Electricity Board.

A Motor Showroom

The two photographs of Messrs. Lambs. Woodford Green, Essex, shown on the next page, illustrate the excellent showroom illumination obtained both inside and from the outside with fluorescent lighting.

This has been achieved by fitting a continuous run of Benjamin Type "G" Flurolier Reflectors, which are the angle version of the Flurolier range, the main axis of light distribution being at approximately 35 deg. to the vertical. Each fitting takes one 5-ft. 80-watt lamp and is finished in "Crysteel"

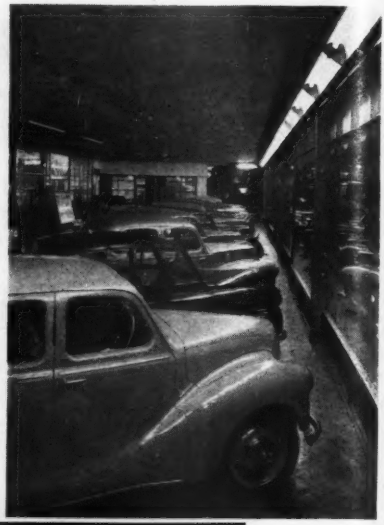
vitreous enamel, white inside and soft grey outside.

The floodlighting of the tower shown in the exterior view is obtained by using two Benjamin 400-watt E.D. Type "S" Rectangular Flood Lanterns having lead-coated steel bodies with ribbed mirrored reflector inside and weatherproof glass front.

The smaller top portion of the tower is illuminated by one weatherproof 300-watt Benjamin Specular Floodlight fitted with ribbed glass heat resisting front lens.

A Dock Installation

Lighting was given high priority among the reconstruction and improvement works undertaken by the Singapore Harbour Board after the war. Very little of the previous installation remained at the end of the Japanese occupation, and the amount of pilfering that went on in the docks at that time necessitated immediate improvement of the lighting. The work has extended over several years in step with the erection of new buildings in the dock area, and has recently been completed. All the lighting equipment was supplied through the Singapore Branch of The General Electric Co., Ltd., which collaborated in the installation with the Electrical Department of the Singapore Harbour Board under the direction of its Electrical Engineer, Mr. Robert Earl.



(*Above*) *Continuous fluorescent lighting in the new showroom of Messrs. Lamb's, Ltd.*

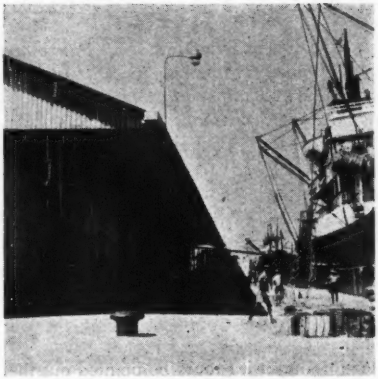
(*Left*) *Exterior night-time view of the showroom.*

All the main lighting is by means of 400-watt mercury lamps in G.E.C. lanterns with bowl difractors. New top brackets were made for the lattice steel standards of the previous installation, giving a mounting height for the lanterns of approximately 30ft. On the wharf itself these standards were spaced about 200 ft. apart so that there is one at each end of all the godowns re-

maining from the pre-war installation. Several new godowns have been built, and for these pipe brackets attached to the godown eaves have been provided for mounting the lanterns. The new godowns are about 340 ft. long, so that three brackets are mounted on each with a spacing of about 175 ft., two being at the ends and one in the centre. The height of the lanterns above the wharf is about 25 ft.

There are approach lanes to the wharf between each block of godowns, and all brackets at the ends of the buildings, both on the lattice posts and on the godowns themselves, are at an angle of 45 deg. to the wharf so that the lanterns serve the approach lanes as well as the wharf area.

In the general roadways behind the blocks of godowns the lanterns are mounted on the pre-war lattice standards at about 30 ft. above road level with a spacing of approximately 220 ft. The roadways average 75 ft. in width. The only additional lighting in this area comes from tungsten lamps in 18-in. R.L.M. reflectors mounted under the godown eaves immediately over the doorways, to supplement the light from the roadway lanterns.



Method of mounting lanterns on the eaves of the godowns built since the war.

A Dress Shop

The lighting of the dress shop shown on p. 44 was carried out by Modern Electric (Installations) Ltd. and is an example of good lighting applied to a small specialist shop. The window lighting is by 5-ft. 80-watt fluorescent lamps fitted behind specially designed bevelled-edged louvres. To break any "flatness" in the light, 150-watt adjustable spotlights have been added. The architect was Cyril Alder, A.R.I.B.A.

Night-time view of the wharf lighting at the docks at Singapore.

REVIEWS OF BOOKS

"Gas Discharge Lamps," by J. Funke and P. J. Oranje. Translated by G. Ducloux-Sutton. N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands, 1951, *price* 30*s. Available from Clever-Hume Press, Ltd., London.* 270 *pp.,* 171 *illustrations, five appendices.*

The English version of Mr. Oranje's book on Gas Discharge Lamps has been rewritten under the joint authorship of Dr. J. Funke and Mr. P. J. Oranje; much new material has been added since the original work was first published on the Continent during the war years.

At the outset it should be pointed out that the title, "Gas Discharge Lamps," is perhaps a little misleading for two reasons: (a) the work deals with the general field of electric discharge lamps, and (b) it deals practically exclusively with the products of the Philips Company. Presumably for these reasons certain important and comparatively recent developments in the field of electric discharge lamps are not mentioned in any detail.

The opening chapters of the work deal with the general theory of discharges through gases or metallic vapours. The treatment is, in general, of an elementary nature but is, no doubt, aimed at the large number of users of electric discharge lamps rather than the advanced students of physics or electrical engineering. Nevertheless, this latter group of readers will find a considerable amount to interest them in the book, particularly in the later sections dealing in some detail with lamp characteristics.

It is perhaps to be regretted that the references at the end of the book deal almost entirely with original papers emanating from the Philips Organisation. This, of course, follows naturally from the fact that the lamps mentioned in the book are the product of this organisation; nevertheless, it must be understood that in practically all cases these lamps are of the same general types developed and manufactured by many other organisations in Great Britain, America and elsewhere.

The value of the book would have been enhanced had it contained a more representative bibliography, such as, for example, that which is published in the Proceedings of the C.I.E. under Technical Committee 21.

H. W. C.

"Industrial High Vacuum," by J. R. Davy, B.Sc., F.P.S. Sir Isaac Pitman and Sons, Ltd. Price 25*s.* 244*pp.,* 82 *figures.*

The last fifty years has witnessed remarkable strides in the development of equipment for the production of high vacua. The Sprengel pump followed by its rotary counterpart the Gaede mercury pump first enabled high vacuum techniques to be introduced into the industrial field actually for the manufacture of electric lamps. The rotary oil pump in its many forms then made its appearance and this was followed at a later date by the mercury vapour jet pump and eventually by the modern oil diffusion pump.

Many of these developments and the industrial processes which have very largely been determined by them form the subject matter of Mr. Davy's book "Industrial High Vacuum." The reader is indebted to him for bringing together a large amount of valuable information both about pumps and processes. In his arrangement of the material at his disposal, however, the author has not been so happy. There is some lack of continuity about the treatment and in a number of cases the author has assumed that the reader will have his own background knowledge and experience in the particular field with which the work is primarily concerned, namely the industrial equipment and techniques used for the deposition of thin films in vacua.

In dealing with this subject Mr. Davy speaks with the authority of experience and his comments will be welcomed by other workers in the same field. After an opening section on High Vacuum Pumps succeeding chapters deal with the Working Chamber, Seals and Gaskets, Valves and Interlocks, Leads, Heaters and Heater Supplies. The main body of the book is concerned with these and other features of the particular usage of high vacuum with which the author is intimately associated. One or two chapters at the end of the book deal with such subjects as Vacuum Metallurgy and Vacuum Dehydration although in the space available the treatment is rather superficial. For this reason it is felt that a more informative title for the work would perhaps have been "The Deposition of Thin Films in Vacuo and other High Vacuum Processes."

When Mr. Davy's book passes to its second edition he may find it valuable to re-organise his material with this in mind. We recommend the work to all those interested in high vacua and particularly to those concerned with thin film production in vacuo.

J. N. A.

I.E.S. ACTIVITIES

Dow Prize Competition

The Council of the Society has for some time been considering an appropriate means of perpetuating the memory of John Stewart Dow, who died in 1948 after having given unbroken service to the Society since its foundation in 1909.

In memory of J. S. Dow, therefore, and in virtue of a bequest by him, the Society now offers a prize which will be awarded to the winners of a competition intended to encourage collaboration between students of illuminating engineering or of those branches of engineering concerned with illumination, and students in other fields in which lighting plays an important part. Mr. Dow was keenly interested in the training and encouragement of students; he was also most concerned with the architectural aspects of lighting and was anxious to see much closer collaboration between architects and lighting engineers. The Dow Prize Competition, in bringing architects and lighting engineers together in the early stages of their respective careers, is therefore a most fitting memorial to J. S. Dow.

While entries for the competition from individuals are not excluded, the competition is primarily intended for students working together and, as will be seen from the conditions for the 1952 competition which are given below, collaboration is certainly advisable. The intention is to hold the competition every two years.

The winning entry will receive a total cash award of £75 (i.e., divided amongst the members of the team submitting the winning entry), and a certificate will be presented to each member of the winning team. This cash award, which is a sizeable one for competitions of this nature, should make the competition most attractive to students. Certificates of commendation will be awarded to any other entries of outstanding merit.

After the announcement of the results of the 1952 competition, the Society intends to arrange a special open meeting at which the entries shall be exhibited and discussed.

In making the arrangement for the competition the Society invited, and has received, the active support and encouragement of the Royal Institute of British Architects and the Institution of Electrical Engineers, and a nominee of each of these bodies serves on the Dow Prize Board, which is responsible for the administration of the competition. The actual details of the competition and the judging of entries is the responsibility of a panel of assessors, whose names will not be made known until after the results have been announced.

The conditions for the 1952 prize are as follows:—

1. The subject for the 1952 competition is the layout, artificial lighting and decoration of a ground-floor showroom.
2. Relevant documents, with instructions as to the form which entries should take, will be available on April 1; forms of application may now be obtained from the Secretary of the Illuminating Engineering Society, 32, Victoria Street, London, S.W.1.
3. The competition is open to anyone who, not having completed his twenty-sixth year by the opening date (i.e., April 1), can show that he is taking or has taken a course of instruction, or has had equivalent training of a nature appropriate to the subject of the competition. All members of a team must comply with these conditions.
4. Candidates must have been born on or after April 1, 1926.
5. The last date for submission of entries is November 30, 1952.
6. Candidates may be required to give to the assessors a verbal explanation of their schemes.
7. In the event of there being no entry of sufficient merit, the award may be withheld.
8. The assessors' judgment of the entries will be final. In all other matters relating to the competition the decision of the Council of the I.E.S. shall be final.

In the first instance those wishing to enter should apply to the I.E.S. Secretary, who will require certain brief details to ensure that the applicant comes within the terms of condition 3. Each member of a team must apply individually; for example, if the team consists of one student of illuminating engineering and one architectural student, then each must make application and satisfy condition 3. It should be noted that the term "student" is fairly widely interpreted for the purposes of the competition.

Details of the competition are being widely

Mr. and Mrs. Lovell receiving guests at the Birmingham Centre Ladies' Evening.

circulated to technical colleges and schools of architecture. It is hoped that I.E.S. members will also give it wide notice and encourage entries. The competition is not, of course, restricted to I.E.S. members.

London

At the sessional meeting held at the Royal Society of Arts on January 8, a paper on "The Control of Lighting by a Lighthouse Lens" was given by Dr. W. M. Hampton. Consideration was given in this paper to the purpose that lighthouse optical apparatus is intended to fulfil. The essential purpose of such a lens is to concentrate as much light as possible in a predetermined direction, and is comparable optically with the production of an image at infinity. The appearance of such a lens viewed from a distance is as though it were filled with light at a comparable brightness with that of the source and is, in lighthouse terminology, "fully flashed." In an optical sense the lenses required for such a purpose are relatively simple.

After a brief historical introduction the author gave the elementary theory of such lenses and other conditions that have to be fulfilled in presenting a complete theory. There followed a brief description of the aberrations which are inherent in the production of beams by such simple lens apparatus, including a description of the effect of the dispersion of the glass on the lens. There are an infinite number of solutions theoretically possible to fulfil the conditions laid down, and reasons were given for the selection of those types of lens which are used in practice. In the approximation to the true curvature of the lens sections it is usual to use a circular curve and it was shown that the effect on the beam of such an approximation is negligible.

The author then dealt with the types of lens needed to give particular types of light beam and the calculation of the intensity given by a lighthouse beam in terms of the brightness of the light-source and the dimensions of the lens.

In the next section of the paper the problem of conspicuity was dealt with, reference being made to the apparent diminution in intensity consequent on the imposition of a flashing character on the light. Methods of calculating this fixed-light equivalent of a flashing light were indicated for the various types of beam in use. Since the ultimate objective of a lighthouse engineer is that the light should be seen at a considerable distance, the paper discussed the relation between the intensity, the atmospheric conditions, and the range at which the light can be seen, and in particular the ranges that can be expected from lights under the different weather conditions covered by the Standard Visibility Codes.

The final part of the paper dealt with the practical application of the theoretical considerations to the design of lighthouses and indicated how the many variable conditions that have to be met in practice are covered by actual lights. There was a brief mention of methods of manufacture, and the paper was illustrated with diagrams and photographs of various lighthouses which have been erected in various parts of the world. These were selected in order to show particular applications of the theoretical requirements that have to be met.

Birmingham Centre

On December 7, 1951, the Birmingham Centre had an all too rare visit of several local architects and architectural students to hear a paper by Mr. Cox, F.R.I.B.A., entitled "An Architect's Approach to Artificial Lighting." In his introduction Mr. Cox stated that the work of the Illuminating Engineering Society was creative and important and that a lighting engineer was a member of a team who should tackle his portion of the job with discretion and taste. He went on to say that the architect was both a designer and co-ordinator, and that

Forthcoming I.E.S. Meetings

LONDON

February 12th

Sessional Meeting. "The Specification and Testing of Fluorescent Lamp Fittings and their Equipment," by W. R. Bloxsidge, G. Fahey, D. T. Waigh. (At the Royal Society of Arts, John Adam Street, W.C.2.) 6 p.m.

CENTRES AND GROUPS

February 1st

BATH AND BRISTOL.—"Lighting of the New House of Commons," by C. Dykes Brown. (At the South Western Electricity Board Lecture Theatre, Colston Avenue, Bristol.) 5.30 p.m.

HUDDERSFIELD.—"Fine Detail," by A. G. Smith. (At the Electricity Showroom, Market Street, Huddersfield.) 7.15 p.m.

February 5th

LIVERPOOL.—"Lighting of an Ocean Terminal," by H. S. Allpress. (At the Lecture Theatre, Merseyside and North Wales Electricity Board's Service Centre, Whitechapel, Live pool.) 6 p.m.

STOKE-ON-TRENT.—"Lighting of Architecture," by G. Grenfell Baines. (At 31, Kingsway, Stoke-on-Trent.) 6 p.m.

February 6th

NEWCASTLE.—"Illumination and Illusion," by P. Hartill. (At the Minor Durrant Hall, Oxford Street, Newcastle-on-Tyne, 1.) 6.15 p.m.

February 7th

NOTTINGHAM.—"Illumination of a Medium Size Factory," by W. K. Martin. (At the Demonstration Theatre, East Midlands Electricity Board, Smithy Row, Nottingham.) 5.30 p.m.

February 8th

BIRMINGHAM.—"Industrial Lighting," by E. H. Norgrove. (At the Imperial Hotel, Temple Street, Birmingham.) 6 p.m.

February 12th

CARDIFF.—"Development of the Tungsten Lamp," by B. P. Dudding. (At the Demonstration Theatre, South Wales Electricity Board.) 5.45 p.m.

February 13th

EDINBURGH.—"Outdoor Decorative Lighting," by H. Carpenter. (At the Welfare Club Hall, 357, High Street, Edinburgh.) 7 p.m.

SWANSEA.—"Development of the Tungsten Lamp," by B. P. Dudding. (At the Minor Hall, Y.M.C.A., Swansea.) 6.30 p.m.

February 14th

GLASGOW.—"Brightness Engineering," by W. Robinson. (At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2.) 6.30 p.m.

LEICESTER.—"Lighting of the *Queen Elizabeth* and *Caronia*," by T. Catten. (At the Demonstration Theatre, East Midlands Electricity Board, Charles Street, Leicester.) 6.30 p.m.

MANCHESTER.—"Lighting and Vision in Advancing Age," by H. C. Weston. (At the Demonstration Theatre, Manchester Town Hall Extension.) 6 p.m.

February 15th

NEWCASTLE.—Annual Dinner and Dance. (At the County Hotel, Newcastle-on-Tyne.) 7.0 p.m.

February 18th

SHEFFIELD.—"Electric Lighting.—A Contractor's Viewpoint," by J. Ashmore. (At the Medical Library, The University, Western Bank, Sheffield, 10.) 6.30 p.m.

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the practice of modern architecture covered all the sciences.

In the approach to a problem Mr. Cox stressed the need for co-operation of the architect and the illuminating engineer and that the aesthetic lighting of modern buildings was a challenge. Any attempt to imitate sunlight would fail. The lighting should be integral with the design of the building; it was easy to criticise the design of some lighting fittings, but this could be countered by criticism of the design of some buildings.

Mr. Cox said the fluorescent lamp had great potentialities for incorporation into modern architectural design, and preferred that the lamp should be well sunk into its surrounding casing. This latter was only another piece of furniture and simplicity should be a constant formula for design. He had found indirect lighting most restful, but suggested the use of prismatic control to get a more even effect. One of the joys of concealed lighting, he said, was the peaceful plain ceiling as a rest from the other parts of a furnished room.

Turning to drama in lighting Mr. Cox said that advice from the lighting engineer in the initial stages would contribute to success in designing effects, and cited several examples of dramatic lighting from the Festival of Britain. Of exterior lighting he said that safety was the all-imporant factor. Speaking about the extra glamorising of buildings at night Mr. Cox made the wry comment that a man would walk past a fine piece of architecture day after day and never notice it, but let it be floodlighted and he would bring his wife and children to see the marvellous sight.

Turning to the future the speaker said that we required cheap electric power at any time and in any quantity, and then we could have decorative schemes of imagination at low cost. There were still unexplored fields of decorative and functional lighting, and these would call for considerable understanding between the two professions.

During the discussion Mr. Howard Long said that this address, with its implications, marked an epoch in the history of the Centre, if not of the Society, and referred to it as interesting, intriguing and exciting. The vote of thanks proposed by Mr. W. T. Wood and seconded by Dr. Willott was loudly acclaimed.

SITUATIONS VACANT

DRAUGHTSMAN required with experience in coloured perspective drawings for electric light fittings manufacturers.—Write F. H. Pride, Ltd., 81, Clapham High-street, S.W.4.

A LIGHTING SALES ENGINEER required for Malaya by old-established firm of Engineers-Merchants. Single man essential. I.E.S. Member preferred, capable of preparing schemes. Pension and bonus schemes.—Full particulars to Box No. 823.

POSTSCRIPT

By "Lumeritas"

In his random review of 1951, published in this journal last month, Mr. Besemer refers to street lighting installations in Liverpool and Eastbourne, where the lanterns have been fixed to building faces instead of being mounted on columns. He laments the fact that this method of lighting streets of moderate width is not more widely adopted. I am with him in this, for I am no admirer of most street lantern columns and would dispense with them wherever possible. Incidentally, the famous "High," in Oxford, and the adjoining Cornmarket-street, are lighted by lanterns attached to the buildings themselves. But I cannot share Mr. Besemer's enthusiasm for the term "foot-candle," nor appreciate the argument in favour of it, for which he applauds a recent article by Mr. R. R. Holmes. Many of us have been to church at some time or another and have seen 2-ft.—perhaps even 3-ft.—candles in the chancel; but they were not the kind of foot-candles of which some lighting people still speak. As for getting "a very positive visual idea" of unit illumination from seeing the illumination produced by an ordinary candle at a distance of one foot, surely many different ideas could be had according to the colour of the surface illuminated, or according to the state of adaptation of the eye if the eye is the object placed one foot away from the candle.

Readers of this journal, who obviously have a more than ordinary interest in light, and many of whom are engaged in "engineering" seeing via lighting, should be among those most conscious of the immense value of sight, and most admiring of anyone who helps the sightless virtually to see. I write this on the hundredth anniversary of the death of Louis Braille, whose system of embossed dot letter symbols is now used for the blind all over the world. Braille's eyes were blinded by an accident when he was only three years of age; he lost the minute receptors they contain—so suggestive of tiny fingers—and could no longer "touch" with them radiant symbols of the things about him, feeling, as it were, the high and low levels by which they are distinctively patterned. But the fingers of the hand could feel textured patterns and, given a suitable code of such patterns, words could be read by hand instead of by eye. The invention of this code was Braille's great achievement; he devised it while still a boy, but he died before it was widely accepted.

"Zebra" crossings, contrary to intention, continue to be sites for road accidents. At an inquest reported on New Year's Day, a coroner described these crossings as "a nightmare to motorists in the dark." The driver of the car involved in the fatality emphatically asserted that the crossing could not be seen as he approached it, and the jury recommended that crossings should be equipped with some form of illumination at night "so as to give greater confidence to both drivers and pedestrians." I understand that in one London borough the effects of an experimental installation of flashing lights at "Zebra" crossings are now being observed.

A reader of the "Listener" has sent me a lighting advertisement cut from that journal, and he has drawn my attention to certain of its contents. The last portion he underlines is the statement "that we allow propaganda to give us a type and intensity of light that is fast ruining it," i.e., our sight. Now what is this type and what the intensity? As to the former, the advertisement tells me nothing, but it seems to invite me to draw a certain conclusion from the second statement underlined by my correspondent, which is, "It is interesting to note that last year in France the use of fluorescent lighting in schools was prohibited." So what? It is also interesting to note that fluorescent lighting is used in some schools in this country. It is even more interesting to note that it is used in some eye hospitals and, from this fact, the only reasonable inference to be drawn is that the eye specialists in charge are satisfied that fluorescent lighting will not harm the sight of their patients. As to the intensity of light we are allowing to ruin our sight, the advertisement is also uninformative: it does not say whether this intensity is greater or less than that afforded by the advertiser's system, nor even what intensity the latter gives. Need I say that this piece of propaganda is wasted on me?